

5.16.11 MOISTURE TESTS (Kansas Test Method KT-11)

a. SCOPE

This method of test covers the procedure for the determination of the moisture content of soil and aggregate. **KT-11** reflects testing procedures found in AASHTO T 217 and T 265.

b. REFERENCED DOCUMENTS

b.1. AASHTO M 231; Balances Used in the Testing of Materials

b.2. AASHTO T 217; Determination of Moisture in Soils by Means of a Calcium Carbide Gas Pressure Moisture Tester

b.3. AASHTO T 265; Laboratory Determination of Moisture Content of Soils

c. CONSTANT MASS METHOD

c.1. Apparatus:

c.1.a. The balance will conform to AASHTO M 231.

c.1.b. Drying oven, thermostatically controlled, preferably of the forced-draft type. It shall be capable of being heated continuously at a temperature of $110 \pm 5^{\circ}\text{C}$ ($230 \pm 9^{\circ}\text{F}$).

c.1.c. Drying pans.

d. TEST PROCEDURE FOR CONSTANT MASS METHOD

d.1. Select a representative quantity of moist soil in the amount indicated in the method of test. If no amount is indicated, the minimum mass of the sample shall be in accordance with the following table:

Maximum Particle Size	Minimum Mass of Sample, g
425 μm (No. 40) sieve	10
4.75 mm (No. 4) sieve.....	100
12.5 mm (1/2 in) sieve.....	300
25.0 mm (1 in) sieve.....	500
50 mm (2 in) sieve.....	1000

d.2. Weigh a clean, dry container with its lid, and place the moisture content sample in the container. Replace the lid immediately, and weigh the container, including the lid and moist sample. Remove the lid and place the container with the moist sample in the drying oven maintained at a temperature of $110 \pm 5^{\circ}\text{C}$ ($230 \pm 9^{\circ}\text{F}$) and dry to a constant mass^a. Immediately upon removal from the oven, replace the lid

and allow the sample to cool to room temperature. Weigh the container including lid and dried sample^{b& c}.

NOTE a: Checking every moisture content sample to determine that it is dried to a constant mass is impractical. In most cases, drying of a moisture sample over-night (15 or 16 hours) is sufficient. In cases where there is no doubt concerning the adequacy of overnight drying, drying should be continued until the mass after two successive periods of drying indicate no change in mass. Samples of sand may often be dried to constant mass in a period of several hours. Since dry soil may absorb moisture from wet samples, dried samples should be removed before placing wet samples in the oven.

NOTE b: A container without a lid may be used provided the moist sample is weighed immediately after being taken and providing the dried sample is weighed immediately after being removed from the oven or after cooling in a desiccator.

NOTE c: Moisture content samples should be discarded and should not be used in any other tests.

e. CALCULATIONS

e.1. Calculate the moisture content as follows:

$$w = [(\text{mass of moisture})/(\text{mass of oven-dried soil})] \times 100 \\ = [(W_1 - W_2)/(W_2 - W_c)] \times 100$$

where:

w = moisture content, percent,

W_1 = mass of container and moist soil, g,

W_2 = mass of container and oven-dried soil, g, and

W_c = mass of container, g.

e.2. Calculate the percent of moisture content to the nearest 0.1 percent.

f. GAS PRESSURE (“SPEEDY”) METHOD

NOTE d: This method shall not be used on granular materials having particles large enough to affect the accuracy of the test. In general any appreciable amount retained on a 4.75 mm sieve. The super 200 D tester is intended to be used when testing aggregate.

f.1. Apparatus

f.1.a. Calcium carbide pressure moisture tester. (**Figure 1**)

f.1.b. Balance shall conform to AASHTO M 231, Class G-2.

f.1.c. Two 31.75 mm (1.25 in) steel balls.

f.1.d. Cleaning brush and cloth.

f.1.e. Scoop for measuring calcium carbide reagent.

g. MATERIAL

g.1. Calcium carbide reagent

NOTE e: The calcium carbide must be finely pulverized and should be of a grade capable of producing acetylene gas in the amount of at least $0.14 \text{ m}^3/\text{kg}$ ($2.25 \text{ ft}^3/\text{lb}$) of carbide.

NOTE f: The “shelf life” of the calcium carbide reagent is limited, so it should be used according to manufacturers recommendations.

h. TEST PROCEDURE FOR SPEEDY METHOD

h.1. When using the 20 g or 26 g tester, place three scoops (approximately 24 g) of calcium carbide in the body of the moisture tester. When using the super 200 D tester to test aggregate, place 6 scoops (approximately 48 g) of calcium carbide in the body of the moisture tester.

NOTE g: Care must be exercised to prevent the calcium carbide from coming into direct contact with water.

h.2. Weigh a sample of the exact mass specified by the manufacturer of the instrument in the balance provided, and place the sample in the cap of the tester. When using the 20 g or 26 g size tester, place two 31.75 mm (1.25 in) steel balls in the body of the tester with the calcium carbide.

NOTE h: If the moisture content of the sample exceeds the limit of the pressure gauge (12% moisture for aggregate tester or 20% moisture for soil tester), a one-half size sample must be used and the dial reading must be multiplied by 2. This proportional method is not directly applicable to the dry mass percent scale on the super 200 D tester.

h.3. With the pressure vessel in an approximately horizontal position, insert the cap in the pressure vessel and seal the unit by tightening the clamp, taking care that no carbide comes in contact with the soil until a complete seal is achieved.

h.4. Raise the moisture tester to a vertical position so that the soil in the cap will fall into the pressure vessel.

h.5. Shake the instrument vigorously so that all lumps will be broken up to permit the calcium carbide to react with all available free moisture. When steel balls are being used in the tester and when using the large tester to test aggregate, the instrument should be shaken with a rotating motion so the steel balls or aggregate will not damage the instrument or cause soil particles to become embedded in the orifice leading to the pressure diaphragm.

NOTE i: Shaking should continue for at least 60 seconds with granular soils and for up to 180 seconds for other soils so as to permit complete reaction between the calcium carbide and the free moisture. Time should be permitted to allow dissipation of the heat generated by the chemical reaction.

h.6. When the needle stops moving, read the dial while holding the instrument in a horizontal position at eye level.

h.7. Record the sample mass and dial reading.

h.8. With the cap of the instrument pointed away from the operator^j, slowly release the gas pressure. Empty the pressure vessel and examine the material for lumps. If the sample is not completely pulverized, the test should be repeated using a new sample. Clean the cap thoroughly of all carbide and soil before running another test.

NOTE j: When removing the cap, care should be taken to point instrument away from the operator to avoid breathing the fumes, and away from any potential source of ignition for the acetylene gas.

h.9. The dial reading is the percent of moisture by wet mass and must be converted to dry mass. With the super 200 D tester the dial reading is the percent of moisture by dry mass, and no further calculation is required.

i. CALCULATION

i.1. The percentage of moisture by dry mass of the soil may be determined from the conversion curve (**Figure 2**)

NOTE k: A conversion curve similar to **Figure 2** is normally supplied with the moisture tester. However, check each moisture tester for accuracy of its gage, or for the accuracy of the conversion curve annually¹. Accuracy of the tester gage may be checked by using a calibration kit (obtainable from the tester manufacturer), equipped with the standard gage; in case of discrepancy, the gage on the tester should be adjusted to conform with the standard gage. For checking the accuracy of the conversion curve, a calibration should be made for meter readings using locally prepared soils at known moisture contents. Also, additional testing may be necessary to extend the conversion curve (**Figure 2**) beyond 44% moisture content.

NOTE l: It may be more convenient for field use of the apparatus to prepare a table of moisture tester readings versus oven-dry moisture content for the moisture tester.

i.2. Determine the percentage of moisture to the nearest whole percent.

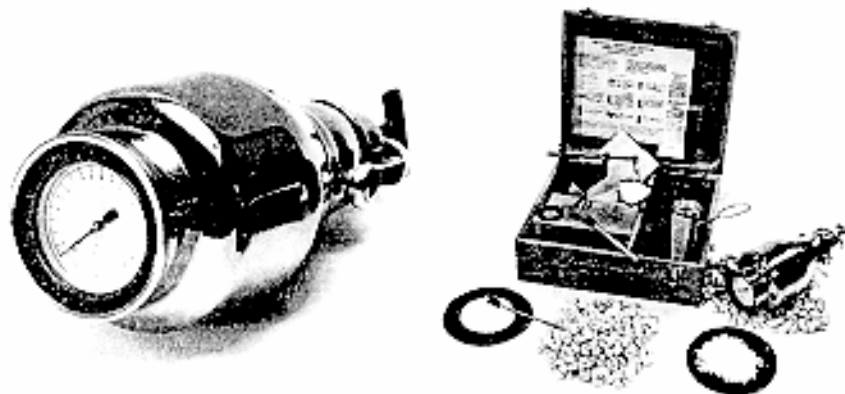


FIGURE 1 Calcium Carbide Gas Pressure Moisture Meter

¹ KDOT requires that each Speedy Moisture tester be checked annually for accuracy of reading.

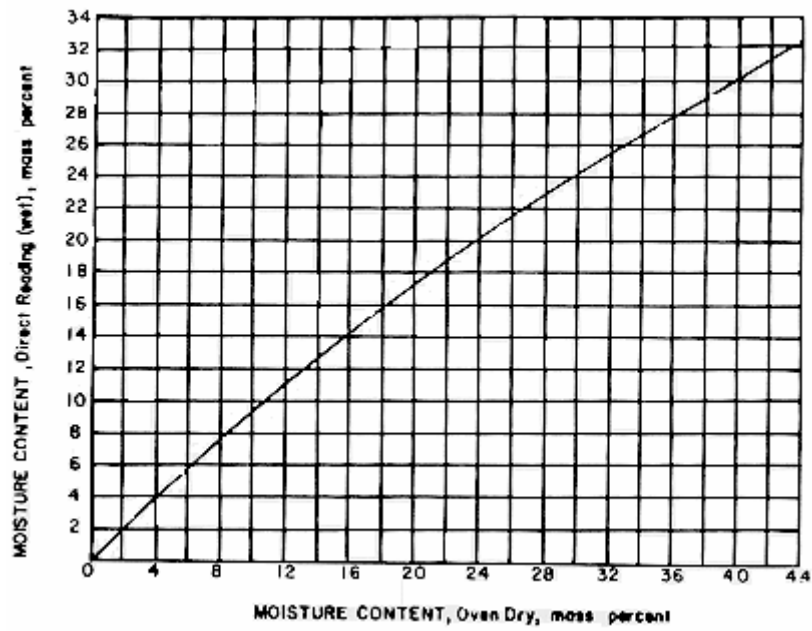


FIGURE 2 Conversion Curve for Moisture Tester Reading